A Note from the Chair
Stephen H. Hickman
USGS

Dear Friends and Colleagues:

As we prepare to gather during the annual PPEM dinner at the Fall AGU meeting, we should congratulate those members of the PPEM community who have received special recognition from AGU for their professional contributions. Among the PPEM members who have been so honored are new 2007 AGU Fellows Susan Brantley, David Pollard and Charles Sammis.

Speaking of the PPEM dinner, we all owe a debt of thanks to the PPEM Dinner Research Team – Steve Blair and Brian Bonner – for once again finding a fine dining establishment for our annual get together. Their culinary research and organizational initiative (and that of their predecessors) always make the PPEM dinner one of the social highlights of AGU week. In addition to enjoying fine food and company, at this dinner we will be toasting two of our most highly regarded colleagues – Brian Bonner and Bill Durham – in celebration of their 60th birthdays. So please come prepared to share your favorite stories or toasts about Brian or Bill!

We should also thank Andreas Kronenberg for maintaining the PPEM web site and sending out periodic job and meeting announcements and Nick Beeler for maintaining and updating the PPEM mailing list. Their efforts are invaluable in making sure we all stay in touch and keep abreast of job announcements, meetings and other activities of special interest to the PPEM community.

Starting this year, the PPEM Steering Committee welcomes new members Joanne Fredrich, Dave Goldsby, Joe Morris and François Renard, who will be joining continuing members Ben Holtzman and Shenghua Mei. Special thanks go out to Steve Karner, Greg Pepin, Jörg Renner, Jeff Roberts and Wen-lu Zhu, who stepped down this year after serving their 3-year terms. If you have any ideas about how the Steering Committee can help promote the science, activities and visibility of the PPEM community, please feel free to contact any one of us.
Among the several announcements in this newsletter, please pay particular attention to the Gordon Research Conference on Rock Deformation, to be held in Tilton, New Hampshire, August 3-8, 2008. The Gordon Conference, which is being organized this year by Greg Hirth and David Prior, has long been one of my favorite meetings and I strongly encourage you to attend.

Finally, I would like to thank Shenghua Mei for serving as new editor of the PPEM Newsletter. Without his efforts, and the contributions of articles and news items by some of you, the Newsletter you see before you would not have happened.

I look forward to seeing many of you at the Empress of China on December 10 for the PPEM dinner, where we will be treated to culinary marvels and good views from a classic San Francisco restaurant!

With regards,

Steve

PPEM dinner will be held on Monday evening, Dec. 10, 2007 at Empress of China, SFO.

For more information about the activity, please see http://geoweb.tamu.edu/tectono/ppe m/PPEM_Dinner.html.

For more information about the restaurant, please see http://empressofchinasf.com/.
Applying Rock Physics to Natural Hazards


Sergio Vinciguerra, Istituto Nazionale di Geofisica e Vulcanologia, Rome
Yves Bernabe, IPGS, Strasbourg

Natural hazards events such as Earthquakes or volcanic eruptions involve activation of coupled thermo-hydro-chemo-mechanical processes in rocks. A conference sponsored by the Italian Istituto Nazionale di Geofisica e Vulcanologia (INGV), the French Centre National de Recherche Scientifique (CNRS) and Exon-Mobil, was held in Erice, Italy, to explore how rock physics experiments and models can help understand natural hazards mechanisms, and, to foster cross-disciplinary collaborations.

The largest part of the conference was devoted to questions related to rock failure and earthquake source mechanisms. Several presentations showed that, despite the huge reduction in scale, laboratory experiments sometimes display phenomena strikingly similar to field observations. For example, new very high slip-rate friction experiments show significantly higher fault weakening than previously observed at the laboratory scale. These exploratory experiments may provide new insights into the mutual interactions of frictional shear failure, heat production and fluid or melt lubrication. Another study revealed that tremor-like events are generated in laboratory samples during melt propagation in cracks or dehydration of hydrated minerals, providing physical constraints to the open debate on the source/origin of volcanic and non volcanic deep tremors.

One fundamental question investigated is how to up-scale the laboratory results to the field scale. Solving this difficult problem requires the active collaboration of rock physics experimentalists and theoreticians with geologists, seismologists and other field scale geoscientists. Several presentations gave an overview of pressure solution creep from grain boundary structure to modelling fault evolution during the seismic cycle. Another area of intense cross-disciplinary collaboration has developed around fault drilling projects such as SAFOD. The structure and evolution of active faults in the earthquake nucleation zone can now be studied in detail through geophysical logs, analysis of cores and the deployment of geophysical sensors for long term monitoring. Forecasting volcanic eruptions, which threaten millions of people in countries like Italy, requires better understanding of their precursors. New physical models and laboratory data were presented to interpret the seismic signals routinely monitored and to define the rock deformation/failure processes within the volcanic edifices.

Many of the techniques and models presented can be applied or tested in geotechnical applications such as geothermal energy recovery or oil/gas production. Several presentations stressed the importance of hydro-
mechanical coupling for optimal reservoir management. Others showed that the physical properties of sedimentary rocks can be more accurately predicted if the chemomechanical processes operating during diagenesis are included in rock physics models.

About 100 scientists attended the conference, held at the Ettore Majorana Foundation and Centre for Scientific Culture (EMFCSC) in Erice, Sicily, from September 25 to 30, 2007. The meeting was the 29th Course of the International School of Geophysics of EMFCSC. Abstracts and presentations can be found at http://legacy.ingv.it/~erice/29Euro_conf/indice.html. The 8th Euro-conference will be organized in Ascona, Switzerland, in September 2009.

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Research Notes

A hybrid self-gasketing “dry” DIA cell

William B. Durham (MIT)
Shenghua Mei (University of Minnesota)
Kurt Leinenweber (Arizona State University)

Pressure medium plays an important role in high pressure studies. The cubic medium that is the basis of the self-gasketing DIA pressure assembly must have sufficient strength to achieve good pressure efficiency and sufficient ductility to form competent gaskets bounding the six anvils. For those experiments to be carried out at anhydrous conditions, the media used in assembly should be virtually anhydrous. On the one hand, although boron-epoxy and unfired pyrophyllite have good strength and ductility, both materials contain considerable water, and it is often problematic in the DIA to measure material properties that are affected by water. On the other hand, while mullite is a good choice to supply an anhydrous environment, it is difficult to be self-gasket due to its crucible feature. In order to measure the rheology of olivine—a material that is known to water weaken—in the Deformation-DIA, we have developed and successfully tested a hybrid cell that combines the dryness and strength of mullite with the self-gasketing properties of unfired pyrophyllite. Conceptually, the cell is a cube of pyrophyllite with a spherical cavity of diameter equal to the edge length of the cube, with a sphere of mullite exactly filling the cavity (see Figure 1). Machining and assembly of the pyrophyllite "web" and the mullite sphere (which can also be made as half-spheres if desired) is not complex. After pressed, gaskets are well-formed along all edges of a cubic cell (see Figure 2).
We have carried out over a dozen runs with the hybrid cell, both on- and off- (synchrotron) line, and have been able to achieve significantly higher pressures and incur fewer blowouts, than with an earlier version of the anhydrous cell made only of mullite. The performance is comparable to that of boron-epoxy, but without the water. FTIR confirms the dryness of San Carlos olivine tested in the cell (see Figure 3).

Figure 1. View of the new hybrid mullite-pyrophyllite cell disassembled (top) and partially assembled (bottom). Mullite sphere diameter and cube edge length are 6 mm. Through hole for furnace, sample, and associated parts has not yet been drilled.

Figure 2. Two views of a hybrid cell assembly after testing in the Deformation DIA. It can be seen that mullite is entirely absent from the gaskets. The gaskets are as well-formed (as pyrophyllite gaskets ought to be). Mullite penetration at the cube faces is evident.

Figure 3. FTIR spectrum of San Carlos olivine single crystal testing in the D-DIA at 1473 K and approximately 5 GPa pressure. The blue curve shows the measured spectrum (black) after removal of background (green-red), and indicates a OH concentration of about 40 ppm, making the sample very dry.
**Problem:** No single cell material in the DIA configuration combines the right characteristics for carrying out creep experiments: strength, self-gasketing capability, and (especially) water content.

Boron-epoxy: too wet  
Unfired pyrophyllite: too wet (and too weak)  
MgO: too weak  
Mullite: too friable

**Solution:** Combine materials into a hybrid D-DIA cell

Embed a sphere of pressure medium inside a cube of gasket material. The drawing here (Figure 1) shows the dimensions of parts for a 6-mm DIA cube. The diameter of the sphere essentially the edge length of the cube. This puts more gasket material where it is needed the most (corners) and none where it is needed the least (center of faces).

The concept is similar to the use of manufactured gaskets in multianvil presses. For example, in the 2-stage 6/8 apparatus, it is common to use MgO as the pressure medium and separate pieces of unfired pyrophyllite as gasketing material. Manufactured gaskets can be made for the DIA configuration (e.g., N. Nishiyama at GSECARS), but the task is complex and time-consuming.

**Result:** No more blowouts.

Versions of 100% mullite cells that we have been using for the past two years invariably produce “mini-blowouts,” which are usually too small to damage anvils but sharp enough to cause sudden displacement of parts in the deformation column—i.e., the sample and alumina piston—with associated degradation of creep data. In several tests of the mullite-pyrophyllite hybrid cell conducted off line and one run conducted at NSLS X17B2, mini-blowouts (and large blowouts) have been entirely absent.

The photo given in Figure 2 shows two views of the one assembly tested at X17B2. It can be seen that mullite is entirely absent from the gaskets. The gaskets are as well-formed (as pyrophyllite gaskets ought to be). Mullite penetration at the cube faces is evident.

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**COMPRES Announcement of new research tools from HPSynC:**

Perfectly shaped samples for high-pressure experiments

We are planning to develop the technique of fabricating small samples for diamond cell experiments, and conducting this survey to find out the community interest.

Experiment can only be as good as its input sample. In high-pressure DAC
studies, we are often limited by our ability of sample fabrication to meet stringent requirements of shape, size, and crystal perfection. For instance, inelastic x-ray scattering and SDW x-ray diffraction. Require perfect single crystals without background scattering from damaged surface. Ultrasonic and Brillouin scattering require parallel surfaces with well-defined thickness. The ideal samples for ultrahigh pressures are typically plates of several µm thickness and several tens of µm width. Micromachining techniques by mechanical polishing, EDM, and Q-switched YAG laser cutting cause several µm surface damages and are typically limited to larger samples. Focused ion beam (FIB) nanofabrication, on the other hand, is too small and too time onsuming. Femtosecond Ti-sapphire laser micromachining plus ion-milling surface cleaning is prohibitively expensive for individual researcher to purchase and operate. If there is sufficient interest among the high-pressure community, the HPSynC would like to collaborate with the optics department of the Advanced Photon Source (APS) at Argonne National Laboratory to develop the capability of fabricating such sample and to make the technique available to users. If you may need such capability, please email your reply at your earliest convenience to HPSynC staff scientist Dr. Yang Ding (email: yangding@aps.anl.gov) by simply add yes to the subject line. Additional comments and suggestions are also welcome.

HPSynC is an infrastructure team dedicated to development of novel high-pressure synchrotron technique at APS, and making the technique available to the high-pressure users’ community.

(Source: Bob Liebermann, COMPRES)

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**Meeting Announcements**

**Gordon Research Conference on Rock Deformation**  
August 3-8, 2008, Tilton, NH  
(Chair: Greg Hirth; Vice Chair: David J. Prior)

The GRC on Rock Deformation highlights the latest research in brittle and ductile rock mechanics from experimental, field and theoretical perspectives. The conference promotes a multi-disciplinary forum for assessing our understanding of rock strength and related physical properties in the Earth. The theme for the 2008 conference is “Real-time Rheology”. Using ever-improving geophysical techniques, our ability to constrain the rheological behavior during earthquakes and post-seismic creep has improved significantly. Such data are used to investigate the frictional behavior of faults, processes responsible for strain localization, the viscosity of the lower crust, and viscous coupling between the crust and mantle. Seismological data also provide information on the rheology of the lower crust and mantle through analysis of seismic attenuation and anisotropy. Geologists are improving our understanding of rheology by combining
novel analyses of microstructures in naturally deformed rocks with petrologic data. This conference will bring together experts and students in these research areas with experimentalists and theoreticians studying the same processes. We will discuss and assess where agreement exists on rheological constraints derived at different length/time scales using different techniques - and where new insight is required. To encompass the elements of these topics, speakers and discussion leaders with backgrounds in geodesy, experimental rock deformation, structural geology, earthquake seismology, geodynamics, glaciology, materials science, and mineral physics will be invited to the conference. Thematic sessions will be organized on the dynamics of earthquake rupture, the rheology of the lower crust and coupling with the upper mantle, the measurement and interpretation of seismic attenuation and anisotropy, the dynamics of ice sheets and the coupling of reactive porous flow and brittle deformation for understanding geothermal and chemical properties of the shallow crust that are important for developing ideas in CO2 sequestration, geothermal and petrochemical research and the mechanics of shallow faults.

For details and information on how to register go to:

The 33rd International Geological Congress
August 6 – 14, 2008; Oslo, Norway

During the period 6–14th August 2008, the 33rd International Geological Congress will be held in Oslo, Norway as a joint venture between the Nordic countries. Excursions will take place both before and after the Congress and cover a wide region, including Greenland, the Faroes, Svalbard, Western Russia, and possibly the UK, in addition to the Nordic countries (Norway, Sweden, Finland, Iceland, and Denmark). The main Congress activities, including the pre- and post congress excursions, will last for almost a month, between July 26th and August 21st 2008.

Several relevant symposia to our community are:

Symposium MPM09 -- Properties and dynamics of mantle and core. Conveners: Eiji Ohtani (Tohoku University, Japan), Geld Steinle Neumann (Bayerisches Geoinstitut, Germany), Bernhard
Steinberger (Norwegian Geological survey), James Connolly (ETH Zurich).

Symposium UHPM03 -- Minerals, microstructures and nanoscale observations.
Conveners: Larissa Dobrzhinetskaya (UC Riverside, US), Harry Green (UC Riverside, USA), and Herman van Roermund (Utrecht University, the Netherlands).

Deadline for abstract submissions is February 1, 2008. For details and information on how to register go to: http://www.33igc.org.

The 16th DRT (Deformation Mechanisms, Rheology and Tectonics) meeting was hosted by the University of Milan at end September 2007, Italy. It was decided that the next DRT meeting would be jointly hosted by the Universities of Manchester and Liverpool in the UK in 2009. The most likely time for the meeting will be early September.

-- Submitted by Ernie Rutter

Book Announcements

2008 Annual Meeting of COMPRES will be held on June 25-28, 2008 at the Cheyenne Mountain Resort in Colorado Springs, Co (For more information of the resort, please see http://www.cheyennemountainresort.com). The schedule of the meeting will follow that of previous years: Arrival in late p.m. on June 25 (Wednesday) and departure after lunch on June 28 (Saturday). For more information, please see: http://www.compres.stonybrook.edu/Meetings/index.html

A new book on “Deformation of Earth Materials: An Introduction to the Rheology of Solid Earth” by Shun-ichiro Karato will be published in February, 2008 by Cambridge University Press. A flyer on this book will be available at the exhibition booth at the 2007 Fall AGU Meeting.

Rock physics and geomechanics in the study of reservoirs and repositories.
The book is a compilation of papers following the Euroconference in Rock Physics and Geomechanics which was held in Ile d'Oléron (France) in 2005. The organizers were Mickael le Ravalec-Dupin and Christian David.
The Department of Geological Sciences at Brown University is pleased to announce that Dr. Greg Hirth has recently joined our faculty. In addition, Dr. Ory Dor and Dr. Phil Skemer have recently joined us as postdoctoral Research Associates. This brings to 9 the number of PhDs in rock mechanics currently at Brown, including Reid Cooper (Professor), Jan Tullis (Professor), Terry Tullis (Emeritus and Research Professor), David Goldsby (Senior Research Associate), Brian deMartin (Research Associate), and Jun Muto (Visiting Scientist).

--Submitted by Terry E. Tullis

Wenlu Zhu and Joe Walsh are honored with 2007 Best Research Paper in Rock Mechanics Award from the American Rock Mechanics Association (ARMA). An award ceremony will be held in 2008 Rock Mechanics Symposium in San Francisco.

– Submitted by Wenlu Zhu

NSF grants for Developing Global Scientists and Engineers (International Research Experiences for Students (IRES) and Doctoral Dissertation Enhancement

NSF continues to solicit proposals for the Developing Global Scientists and Engineers program. This program is intended to provide highest-quality international research experiences for U.S. students via two components: (1) International Research Experiences for Students (IRES), which support groups of U.S. undergraduate or graduate students conducting research abroad in collaboration with foreign investigators and (2) Doctoral Dissertation Enhancement Projects (DDEP), which support the dissertation research abroad of one doctoral student in collaboration with a foreign investigator. Approximately $2.1 million is expected to be available annually to support 24 grants. Proposals generally must be submitted by U.S. institutions, organizations or professional societies on behalf of principal investigators. DDEP proposals must be submitted by faculty advisors of graduate students whose dissertation projects are the subject of the proposals. IRES proposals are due Feb. 15 and Sept. 15, annually; DDEP proposals may be submitted at any time. For more information, visit: http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=12831